Claims

1. Method for the production of a nucleic acid molecule comprising the steps:
   a) Coupling one end of an oligonucleotide to a solid matrix wherein the coupling is effected by means of a modification and the oligonucleotide contains a recognition sequence for a type IIS restriction enzyme which cleaves outside its recognition sequence,
   b) adding an additional oligonucleotide which is at least partially double-stranded and contains a different recognition sequence than in step a) for a type IIS restriction enzyme which cleaves outside its recognition sequence, whereby this oligonucleotide cannot bind to the matrix,
   d) ligating the oligonucleotides from steps a) and b) in the orientation determined by the blockage of the ends that are not to be ligated,
   e) removing non-consumed reactants and enzymes,
   e) cleaving the ligation product from step c) with a type IIS restriction enzyme which cleaves outside its recognition sequence whereby the cleavage occurs in the oligonucleotide from step a),
   f) separating the nucleic acid molecule elongated in this manner from the reaction mixture.

2. Method for producing a nucleic acid molecule comprising the steps:
   a) to d) as claimed in claim 1,
   e) cleaving the ligation product from step c) with a type IIS restriction enzyme which cleaves outside its recognition sequence whereby the cleavage occurs in the nucleic acid sequence of the oligonucleotide from step b),
   f) separating the reaction mixture from the elongated oligonucleotide from step a) that is obtained in step e),
   g) repeating steps b) to f) at least once.

3. Method as claimed in claim 2, additionally comprising:

h) cleaving the resulting nucleic acid molecule with a type IIS restriction enzyme which cleaves outside its recognition sequence whereby the cleavage occurs in the oligonucleotide from step a) and optionally

i) cleaving the resulting nucleic acid molecule with a typeIIS restriction enzyme which cleaves outside its recognition sequence whereby the cleavage occurs in

the nucleic acid sequence of the oligonucleotide from step b).

4. Method as claimed in claim 3, additionally comprising separation of the resulting nucleic acid molecule from the reaction mixture.

5. Method as claimed in one of the claims 1 to 4, wherein the oligonucleotide used in step b) is a nucleic acid molecule produced by the method as claimed in claims 1 to 4.

6. Method as claimed in one of the claims 1 to 5, wherein an exonuclease and/or phosphatase reaction is carried out as step c') after step c).

7. Method as claimed in claim 6, wherein the reaction mixture of step c') is removed after the reaction.

8. Method as claimed in one of the claims 1 to 7, wherein the end of the oligonucleotide from step a) that is not coupled to the matrix contains a part of a recognition sequence for a type IIS restriction enzyme which cleaves outside its recognition sequence and the other part of the recognition sequence for this restriction enzyme is derived from the oligonucleotide from step b).

9. Method as claimed in claims 1 to 8, wherein the modification is a biotin residue, a digoxigenin residue, a fluorescein isothiocyanate residue, an amino compound or a succinyl ester.

10. Method as claimed in one of the claims 1 to 9, wherein the oligonucleotide from step a) and/or b) has a loop.

11. Method as claimed in claim 10, wherein the oligonucleotide from step a) is coupled via a modification in the loop region to the solid matrix.

12. Method as claimed in one of the claims 1 to 11, wherein the solid matrix is a bead, preferably made of glass or polystyrene, a microscope slide, a DNA chip, the well of a microtitre plate or a test tube.

13. Method as claimed in one of the claims 1 to 12, wherein the solid matrix comprises a streptavidin residue, an anti-digoxigenin antibody or an anti-fluorescein isothiocyanate antibody.

14. Method as claimed in one of the claims 1 to 13, wherein the oligonucleotides from steps a) and b) have mutually complementary single-strand overhangs at their ends to be ligated.

15. Method as claimed in claim 14, wherein the single strand overhangs are 1, 2, 3, 4 or 5 nucleotides long.

16. Method as claimed in claims 1 to 15, wherein the various type IIS restriction endonucleases are replaced by ribozymes which cleave in an analogous manner.

17. Method as claimed in one of the claims 1 to 16, wherein the oligonucleotide in step b) is a PCR product, a plasmid vector, a phage or viral DNA, an artificial chromosome or another synthetic DNA.

18. Kit for the production of a nucleic acid by the method according to the invention as claimed in one of the claims 1 to 17 comprising:
    a) a library of 1 to 1,048,576 different oligonucleotides wherein the oligonucleotides can be coupled to a solid matrix by means of a modification at one end and the oligonucleotide contains a recognition sequence or a part of the recognition sequence for a type IIS restriction enzyme which cleaves outside its recognition sequence,
    b) an additional library of 4 to 1,048,576 different oligonucleotides wherein

each of the oligonucleotides contains a recognition sequence for a type IIS restriction enzyme which cleaves outside its recognition sequence which is different from the type IIS restriction enzyme from a), and optionally contains the other part of the recognition sequence of the restriction enzyme from step a),

c) a solid matrix,

d) reservoirs for the enzymes required to produce the nucleic acid molecule and/or other reagents.

19. Device for the automated production of a nucleic acid molecule by a method as claimed in one of the claims 1 to 16, characterized in that it contains

a) a library of 1 to 1,048,576 different oligonucleotides wherein the oligonucleotides can be coupled to a solid matrix by means of a modification at one end and the oligonucleotide contains a recognition sequence or a part of the recognition sequence for a type IIS restriction enzyme which cleaves outside its recognition sequence,

b) an additional library of 4 to 1,048,576 different oligonucleotides wherein each of the oligonucleotides contains a recognition sequence for a type IIS restriction enzyme which cleaves outside its recognition sequence which is different from the type IIS restriction enzyme from a), and optionally contains the other part of the recognition sequence of the restriction enzyme from step a),

c) a solid matrix,

d) reservoirs for the enzymes required to produce the nucleic acid molecule and/or other reagents and

e) a control program which can identify individual oligonucleotides from a) and b), contact them with the solid matrix from c) and with the required enzymes and/or other reagents from d) and determine and carry out the synthesis steps.

20. Use of a nucleic acid molecule produced according to one of the previous methods as a DNA vaccine, to analyse protein domains, as a template for designer proteins, for rapid protein synthesis, for the production of ribozymes or aptamers, as a probe for the detection of pathogenic microorganisms, as a probe for the detection of the expression of genes, for the detection of allele-specific

mutations, for the detection of protein/protein binding, protein/peptide binding and/or the binding of low-molecular substances to proteins.